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AUTHOR Kipper, Philip S.
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ABSTRACT

As the viewer watches the opening credits for the program "Entertainment Tonight," the screen comes to life with rotating shapes and spinning geometric patterns. One has the sense of travelling on an imaginary voyage through space. Many of the computer generated displays common now on television use such visual devices as linear perspective, overlapping, and image transformation and rotation to give the impression of a third dimension on the two-dimensional screen. While a number of studies have indicated that such computer generated displays inflict pain and confusion upon the viewer, another interpretation is that the continued presence of such content may be educating viewers to a new aesthetic appreciation of three dimensional depth information, motion, and image transformation. While evidence for this conclusion is largely anecdotal, a body of experimental work suggests that viewers of computer generated presentations and similar video game displays benefit cognitively from their experiences and reach a new level of visual sophistication. Further research in this area is required. (20 references) (Author/GL)

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TELEVISION'S COMPUTER IMAGERY AND A NEW SPATIAL AESTHETIC

By Philip S. Kipper

Associate Professor
Broadcast Communication Arts Department
San Francisco State University
1600 Holloway Avenue
San Francisco, CA 94132
(415) 338-2772

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ABSTRACT

As the viewer watches the opening credits for the program Entertainment Tonight, the screen comes to life with rotating shapes and spinning geometric patterns. One has the sense of traveling on an imaginary voyage through space. This paper explores the perceptual conditions that allow us to comprehend and enjoy such computer generated images. The paper points out that many of the computer generated displays common now on television use such visual devices as linear perspective, overlapping, and image transformation and rotation to give the impression of a third dimension on the two-dimensional television screen. This paper concludes by arguing that the continued presence of such content may be educating viewers to a new aesthetic appreciation of these key visual elements.

INTRODUCTION

Fisk and Hartley (1978, p.66), in their discussion of the codes of television, remind the reader that one of the functions of art is to make the familiar seem visible in a new way. The newness to which they refer resides in the opposition between the novel aesthetic code devised by the artist and the viewer's normal codes of perception.

But television, according these writers, behaves much differently. Its visual codes relate so closely to the normal codes of perception that television does exceptionally well at making the familiar look familiar. It thus blurs the distinction between televisual codes and the codes of real life--between television and reality.

Fisk and Hartley are worried about this television trait because they believe viewers may be easily misled or manipulated by the medium. But the reason for mentioning these arguments here is to point out that the authors may have been premature in their judgment of television, at least with respect to the purely visual. Much of the newest television content--that which is computer generated--has but one "real life," and that is on the video screen itself. The rapidly moving shapes and wildly changing contours that often greet the viewer represent in many cases a novel visual experience. This experience may not only leave our culturally controlled codes of interpretation at a loss, but more important, these images challenge our more fundamental perceptual and cognitive strategies. This paper is about such content and about the information processing demands it makes on the viewer. The paper will argue that the continuing appearance of these dynamic new computer designs is teaching viewers

a new appreciation for visual images that move and transform themselves, and seem to occupy three-dimensional space.

The computer imaging techniques that gave rise to these video innovations are largely the result of years of experimentation in computer graphics laboratories such as the one at the University of Utah. Lewell (1985) notes that among the key problems faced by researchers was how to describe the shapes and appearances of objects to a computer; how to create three-dimensional shapes that were not simply cones or cylinders; how to create surfaces, textures and shading that lent a sense of realism; and how to create motion and object rotation that approximated the flowing motion of objects in the real world.

Each of these problems required working out complex algorithms and the development of computer programs that allowed assembly of images pixel by pixel. At first, such imaging techniques were used for military or scientific applications. A notable example viewed by millions on television was the simulated fly-by of Saturn by the spacecraft Voyager 2, prepared in 1981 for the Jet Propulsion Laboratory by James Blinn, a University of Utah alumnus. But by the mid-1980s organizations such as Pacific Data Images of Los Angeles were using the new computer graphics techniques to design special openings and show titles for the three major television networks (Rivlin, 1986, p.102) and KRON-TV in San Francisco had installed three Aurora video graphics systems that were used for program openings and weather report animation (Lewell, p. 94). Also by the mid-1980s advertisers were using computer graphics techniques with stunning effect. Viewers were captivated, for example, by the Norelco Shaver commercial produced by Mathematical Applications Group

Inc., which turned a simple electric shaver into a speeding space vehicle (Rivlin, 1986, p. 122).

INVESTIGATION OF AN EXAMPLE

To better understand the impact of these new computer designs, consider one of the most widely viewed examples, the opening segment of the syndicated program, Entertainment Tonight. Like similar well known computer generated displays, such as those used to introduce CNN Prime News and ABC Sports, the Entertainment Tonight segment presents the viewer with a rapidly moving set of images that seem three dimensional on the two-dimensional screen surface.

The viewer first sees a grid of rectangular bars across the screen and beyond two cube-like shapes that seem to be moving closer. The viewer speeds[1] forward through the grid into a seemingly vast space defined by converging lines that extend into the distance. Above is an apparently infinite ceiling of dark blues and reds.

The cubic shapes continue to move closer and soon the viewer is flying down a long narrow corridor. A moment later, the cubic shapes and the corridor start to fall away and rotate to the left. Light projects up around the edges of the cubes and through rectangular openings in their surfaces.

As the shapes continue to fall away, the viewer can begin to see that the shapes are transforming themselves into the letters, ET. In a few seconds, they are further transformed into the complete Entertainment Tonight logo.

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[1]In such images there is no camera viewpoint as such. It is thus the viewer's observation point that seems to move.

In the final portion of the sequence, the program logo drops down in the screen and the viewer can see through a red frame to the studio with the two program hosts in the background. There is now a zooming effect and the letters vanish from the screen as the hosts, shown in a medium shot, begin to speak. The entire segment has lasted about 15 seconds.[2]

In evaluating such quick and complex visual events it is unwise to use such terms as "comprehension" or "understanding" in the sense of a logical, verbal or symbolic interpretation. Certain meanings may be conveyed such as "space travel" or "rapidly changing billboard," or simply, "eye-catching visual display." But the main impact of these images rests more firmly in the realm of perceptual experience. Much like the reception of music, the observation of such images may engender feelings or awareness--perhaps ranging from irritation to pleasure. But they are less likely to initiate a chain of symbolic thought, as might a simple printed sentence.

Generally speaking, such displays possess the following major visual elements: 1. The use of linear perspective to create the illusion of three-dimensional space; 2. Image rotation to convey the illusion that the viewer was moving around the main objects depicted; 3. Rapid movement along the Z axis (to or from the viewer); 4. Nonrepresentational shapes that transform in appearance; 5. Shading, highlighting and shadows to convey three dimensionality; 6. Overlapping or occlusion to suggest volume.

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[2]This program opening was replaced in 1988 with a shorter version in which the program logo appears almost immediately in glossy or highly illuminated letters.

Let us examine more carefully several of the most prominent of these visual elements.

Linear perspective and Z axis motion.

Clearly the aim of the creators of the Entertainment Tonight opening and similar presentations is to give the viewer the impression of a three-dimensional visual world on the two-dimensional television screen. One of the chief ways this objective is reached is through the use of linear perspective--the depiction of seemingly parallel lines that converge. During much of the Entertainment Tonight segment, lines project up from the bottom of the screen, giving the impression of a wide surface reaching to infinity. The effect is enhanced by the use of a colored surface that extends from the top of the screen. As the two surfaces join at the "horizon," the viewer receives the impression of a vast plain stretching out to meet the sky.

A somewhat subtler perspective effect is achieved as the viewer "flies" toward the grid of rectangular bars in the beginning of the sequence. The grid itself is perceived as three-dimensional because the surfaces that form the openings in the pattern of crossed bars converge toward one another. Each opening thus appears as a rectangular tunnel through which one can see the cubic shapes as they float above the infinite plain. Soon the grid approaches and the viewer seems to pass through one of the tunnels.

But the most pronounced perspective effect unfolds a few seconds later as the viewer speeds towards, then passes between, the two cubes. The "walls" forming the corridor speed by as if emanating from a single point of infinity. The sharp convergence of the walls and their flowing motion past the viewer's point of observation

creates a strong sense of three-dimensional depth, as well as enormous speed.

Though the use of linear perspective in these cases seems to follow the principles developed over centuries by artists such as Da vinci (see Vero, 1980), there are several important distinctions that can be made. First, the images are not representational but highly abstract. The converging lines have a geometric regularity, rare in representational paintings, photographs or video images. The perspective effect thus tends to be brought more clearly to the attention of the viewer. The outcome is somewhat similar to that achieved by forced perspective in theatrical staging where the depth of a scene is amplified by building the walls, and floor of a set so they converge (Zettl, 1973).

A further novelty is the presence of rapid motion along the Z axis. The observer of ordinary pictorial material never experiences a viewpoint that hurtles quickly toward infinity. The effect is even rare in conventional motion pictures where it is difficult to achieve except through complex special effects such as those used in the battle scenes from the film Star Wars. Motion, which will be discussed further below, is not in itself a graphic depth indicator. That is to say, it cannot be used in still images to create the illusion of three-dimensional space. However, when rapid motion is coupled with pictorial spatial cues such as linear perspective, the sense of three dimensionality is exaggerated. The effect is achieved as the converging parallel lines or surfaces flow by and the point of infinity seems constantly to change. J.J. Gibson (1979, p. 227) suggests that such perceptual changes are crucial in normal experience to the control of body motion. The rate at which surfaces

and lines seem to flow toward or away from us provides information about the speed of movement so the body can react by tensing muscles to maintain stability. Similarly, Braunstein (1976, p.46) observes that we use the progressive convergence of lines as an indicator of distance. It is the systematic and expected joining together of the lines that contains the information about depth, in the same way as does the observation of a uniformly textured surface; we expect the texture to be more apparent closer up than farther away.[3] But in the case of the Entertainment Tonight opening and other similar computer generated images, the visual information comes so rapidly that it may defy or challenge ordinary perceptual expectations, which are acquired, after all, through such mundane activities as walking. It is thus hard to imagine this use of linear perspective and motion having any other effect than the one apparently intended by the creators--an exhilarating, or perhaps disquieting,experience of rocketing through three-dimensional space.

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[3]Braunstein argues that linear perspective is in fact a special case of texture gradient, which he believes to be one of the main sources of information about depth in normal experience. The principle can be understood by looking down a long straight country road. The texture of the asphalt close to the observer is readily apparent. Farther away the road seems shiny and smooth. Information about distance and our own forward motion is contained in the progression from roughness to smoothness. Braunstein says that this texture progression or gradient is almost identical to the rate at which the parallel lines formed by the edges of the road converge in the distance.

Motion, occlusion and relative speed

Motion is without doubt the key visual element used in the Entertainment Tonight opening as well as in similar computer generated displays. The viewer seems to be moving past and through objects, flying toward them and circling above.

All this movement, generally speaking, has three major effects: It changes the viewing angle so the apparent form of objects changes; it reveals new surfaces that were once concealed, while concealing or occluding others; and it sets up a relationship of speed between objects so that those that seem near move faster than those farther away. The sum of these effects is not only an experience of complex visual activity, but an amplified sense of three dimensionality.

Change in apparent viewing angle is one of the most important sources of information about the three-dimensional form because it causes geometric transformations within the visual field. The outcome of this process was illustrated simply by researchers Wallach and O'Connell (1953), who projected the shadows of trapezoidal shapes on a two-dimensional screen. When the shapes were rotated they seemed three dimensional. This illusion, named the kinetic depth effect, was also achieved using animation or motion picture techniques in which geometric figures were depicted from progressively different viewing angles or rotated in front of a camera (Green, 1961; Hay, 1966).

The significance of such experiments was to show that progressive or systematic geometric change is a key indicator of depth. As objects move or as the observer moves, the observed angles, edges and lines of the environment change. Such change, in effect, is visual information about whether objects are moving

towards us, turning away or remaining relatively still in relation to our vantage point. In addition, such motion helps define or clarify the true shape of an object.

In displays such as the Entertainment Tonight Opening, this motion-supplied information not only is essential to the illusion of three-dimensionality on the flat screen but it contributes powerfully to the excitement value and attractiveness of the images. The rate of motion is so fast that the screen bombards the viewer with transforming shapes and consequently with a high rate of geometric information.

Another important element of change in the Entertainment Tonight opening that relates to motion has to do with the principle of surface overlapping, a key graphic depth indicator. When the surface of one object is partly concealed or occluded by another it is a sign that the two objects rest at different positions in three dimensional space. In a still image such as a photograph or painting these overlapping relationships are fixed. But in moving images they may change. Motion assures that the surfaces in a visual display engage in a dance of occlusion and revelation.

The creators of the Entertainment Tonight opening and similar displays, have used the overlapping principle to create visual interest by making strikingly clear to the viewer the visual consequences of motion. The grid of bars at the start of the sequence partially covers the infinite plain and the two cubic shapes. But as the bars come closer a wider view of these background images is revealed. Later as the viewer seems to fly between the two cubes, only a small portion of the plain can be viewed below. Then as the viewer seems to fly upward, the plain becomes more prominent.

This rapid activity of covering and uncovering again conveys the powerful impression of three-dimensionality. Not only do the surfaces stand at differing locations in three-dimensional space, but because the surfaces are at varying distances, ranging from close to far, the volume of space is more clearly defined. It is a good example of what Zettl (1973) calls articulating the Z axis.

A further outcome of the changes in overlapping is to enhance the illusion that it is the viewer's own movement that accounts for the altering landscape. It is this latter effect that is likely to have the greatest impact simply because it suggests the viewer's involvement in a high velocity visual adventure that would rarely, if ever, be encountered in the real world.

Finally, the speed of motion itself plays a role in the perception that these images possess depth and volume. Researchers have demonstrated, for example, that by simply animating dots against a dark background and having them pass across a screen in opposite directions and at differing speeds an illusion of depth is created (Braunstein, 1966; Mace & Shaw, 1974). The effect takes place because a moving observer expects objects that are closer to move relatively more quickly than objects farther away. This phenomenon can be witnessed by looking out the side window of a moving automobile. Trees or parked cars close to the road will rapidly speed past relative to the position of the observer and the edge of the window. Buildings or mountains in the distance will remain longer within the field of view. It is this variance in the relative speed of objects that signals a difference of position in space and thereby creates the impression of depth.

Though this effect is not pronounced in the Entertainment Tonight Opening, it does exert some influence. In the beginning of the segment, for example, the grid of bars occupies the foreground while the cubic shapes are in the background. As the viewer approaches the grid it quickly whips out of view while the shapes remain relatively motionless. The most powerful impact of this effect is to suggest the great distance between the grid and the shapes--a distance the viewer will traverse in but a second or two. Once again the outcome is an experience of extremely rapid motion through three dimensional space.

Image Transformation

One of the cognitive skills that is put to the test by many computer generated images is the viewer's ability to perceive an object's radical transformation in appearance due to change in viewing angle. For example, in the Entertainment Tonight opening as the viewer seems to fly out of the corridor between the two cubic shapes, these forms rotate below and then seem to move into a vertical position. From this new viewing angle it is clear that what has been observed all along were the edges of block letters, which now clearly spell out the name of the program.

Neisser (1976, p. 145) suggests that for viewers to accept and interpret such transformations they must possess mental schemata or expectations about the behavior of objects. In the simplest terms, the viewer must know that by changing viewing angle or by rotating an object, its appearance may alter radically. So the basic expectation is simply one of potential change. Neisser further observes, however, that if the viewer possesses expectations of what the transformed appearance might be, the act of perception and

interpretation is made easier. In other words, the transformed appearance of a well known object or one that has been previously described will be more easily recognized and interpreted than that of a novel object.

This latter conclusion seems to suggest that viewers of images such as those in the Entertainment Tonight opening may be confused or disoriented by the types of transformations that take place. On first viewing, for example, there is little information to prepare the viewer to interpret two cubic shapes that quickly change into block letters. Doesn't such a transformation seem strange or puzzling?

In fact, it is highly unlikely that many viewers are troubled by such visual events, though they may not be able to interpret them logically or verbally. The reason, as Neisser and others who have studied cognitive processes and mental imagery make clear, is that human beings are enormously flexible in their ability to imagine changes in the visual appearance of objects. Furthermore, as Kosslyn (1983) suggests, the visual imagination--the ability to visualize objects and events--can be highly inventive.

It is beyond the scope of this paper to explore the relationship between computer generated images and the capability of mental imagery. However, it can be noted that many of the visual transformations and cognitive activities apparently evoked by displays such as the Entertainment Tonight opening bear a powerful resemblance to the acts of mental image rotation and other visualization processes described by researchers. Vandenberg and Kuse (1978), for example, have devised a test of visual imagination that asks subjects to mentally rotate images that look very much like

the Entertainment Tonight cubes. Results of the test indicate that there is an innate ability, which may vary from individual to individual, to mentally alter and examine three dimensional shapes and make judgments about their transforming appearance.

Shepard (1978) writes that mental imagery is remarkably able to substitute for real perception. He goes on to note that spatial and formal transformations of imagined objects are apparently an ability possessed by most people as a result of "eons of evolution in a three-dimensional world." Perhaps one of the reasons computer generated images are so attractive and provocative is because they provide a vivid analogue of our internal visualization processes.[4]

CONCLUSIONS

This discussion of the Entertainment Tonight opening as an example of television's new computer generated images was meant to suggest the density and complexity of such displays. This paper has intentionally used such exotic phrasing as "rocketing," "bombard," or "stunning" to convey the idea that the viewer experiences a welter of visual information--usually in a very short time.

Some writers have suggested that such displays may indeed confuse or startle the viewer, perhaps even causing apprehension or disorientation. Metallinos and Chartrand (1987), for example, are troubled by rapid Z axis motion, which they believe may be perceived as unnatural or unbalancing.

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[4]Interestingly, Kosslyn (1983) proposes a computer metaphor to explain the nature of mental images and how they are "observed" in the mind.

There is some circumstantial evidence supporting this point of view, most of it from perceptual psychological studies that used tachistoscopes and other mechanical devices for generating visual input. In addition, Metallinos and Chartrand cite studies of heavy video game users who experienced "perceptual and emotional numbing."

The analysis in this paper does not necessarily contradict these allegations. However, it does suggest another possible interpretation. Rather than inflicting pain and confusion upon the viewer, these computer generated displays are perhaps educating viewers to a greater appreciation of three dimensional depth information, motion and image transformation. Such displays not only possess a visual "style" to which the audience is becoming accustomed, but viewers are perhaps gaining more awareness of the elements of that style.

Evidence for this conclusion is largely anecdotal. Many viewers are clearly attracted to and entertained by visual material like the Entertainment Tonight opening. But there is also a body of experimental work that seems to suggest that viewers of computer generated presentations and similar video game displays benefit cognitively from their experiences. Zavotka (1987) showed that children improved spatial drawing skills by viewing computer animated graphics that had three-dimensional information in them. Gagnon (1985) found a positive correlation for adults between experience with three dimensional video games and scores on tests of spatial perception ability. Lowery and Knirk (1982-83) found that children who frequently played computerized video games improved their ability to visualize three dimensional scenes.

Though such studies have only a limited application to a general viewing audience, they at least seem to indicate that viewers who encounter computer generated imagery on television may be positively influenced by the experience. This paper has pointed out that computer displays like the Entertainment Tonight opening bring vividly to the viewer's attention such three dimensional indicators as linear perspective, Z axis motion and overlapping. In addition, the paper has suggested that viewers who watch such material are likely to be made aware of the speed and facility with which visual images change in appearance due to motion and altered viewpoint. If indeed viewers are acquiring such new awareness, then it is clearly possible that computer generated images on television are contributing to a new level of visual sophistication. This is an important issue that demands further investigation.

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